Faculty of Cognitive Science and Human Development

THE DESIGN AND EVALUATION OF A WEB-BASED LEARNING

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by

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This project is submitted in partial fulfillment of the requirement to obtain a
Bachelor of Science (Cognitive Science) from
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Dedication

This thesis is dedicated with love to my beloved parents,
Dad and Mum...

ACKNOWLEDGEMENT

First and foremost, I would like to praise the Lord for giving me the strength and all his blessings that I am able to finish my final year project successfully.

I would like to thank to my supervisor, Dr.Ngu Bing Hiong for her invaluable guidance and professional advice in helping me throughout this project.

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Learning is what people do to develop their skills and knowledge in order to do things better. Nowadays, a well-developed technology has resulted in the emergence of a web-based learning method as a replacement for classroom learning. Web-based learning is a form of distance learning, where learners can learn through the World Wide Web. The purpose of this study is designing and evaluating a web-based learning environment. It aims to identify students' perception towards the design of Web-based learning Mandarin, their perception towards web-based learning Mandarin, the capacity of cognitive load and the effectiveness between the web-based learning and the classroom learning. The finding of the study revealed that although the design of the 'web-based learning' and the method of web-based learning itself are well received by students, the classroom learning method is more effective than the web-based learning method. One of the reasons is the classroom learning method need a less capacity of cognitive load than the web-based learning method. However, as indicated by the students, learning through the web can be an exciting experience and it has the potential as a virtual classroom in the future. Anyway, it is recommended to have more studies on web-based learning which considers different contents for learning.

ABSTRAK

THE DESIGN AND EVALUATION OF A WEB-BASED LEARNING

Kee Jing Jing

Pembelajaran merupakan suatu proses yang dilakukan oleh manusia untuk meningkatkan kemahiran dan menambah pengetahuan mereka supaya mereka dapat menghasilkan kualiti kerja yang lebih baik. Dengan berkembangnya teknologi yang semakin canggih, wujudnya satu cara untuk pembelajaran iaitu melalui web yang cuba menggantikkan cara pembelajaran dalam kelas. Pembelajaran melalui web juga merupakan pembelajaran jarak jauh, di mana pelajar boleh belajar melalui World Wide Web. Objektif kajian ini ialah merekabentuk dan menilai suatu persekitaran pembelajaran melalui web. Ia bertujuan untuk menentukan persepsi para pelajar terhadap cara pembelajaran Bahasa Mandarin melalui web, persepsi para pelajar terhadap persekitaran pembelajaran melalui web, kapasiti muatan kognitif dan juga keberkesanan antara cara pembelajaran melalui web dengan cara pembelajaran dalam kelas. Daripada dapatan kajian, walaupun pelajar-pelajar adalah berpuas hati terhadap rekabentuk web dan bersetuju bahawa penggunaan web boleh digunakan sebagai media pembelajaran, namun hasil kajian ini telah menunjukkan bahawa cara pembelajaran dalam kelas yang memerlukan kapasiti muatan kognitif yang lebih rendah adalah lebih berkesan jika dibandingkan dengan cara pembelajaran melalui web yang memerlukan kapasiti muatan kognitif yang lebih tinggi. Pelajar berpendapat bahawa pembelajaran melalui web adalah merupakan satu pengalaman yang amat menyeronok dan ia adalah amat berpotensi untuk dijadikan sebagai satu kelas maya pada masa yang akan datang. Walau bagaimanapun, adalah dicadangkan supaya lebih banyak kajian tentang pembelajaran melalui web yang melibatkan bahan pembelajaran yang berlainan dijalankan.

CHAPTER ONE
INTRODUCTION

1.0 Introduction

Learning is what people do to develop their skills and knowledge in order to do things better. It is central to all societies either rich or poor. That is the general term used to describe the changes in behavior potentiality resulting from experience or training. Learning can be defined as an experiential process resulting in a relatively permanent change in behavior that cannot be explained by temporary states, maturation or innate response tendencies (Gerow, 1993).

As stated by Ehrmann (1996) of the Educational Strategies Program of the Annenberg/CPB Project at the Corporation for public Broadcasting, most students can express themselves better via e-mail than face-to-face instruction. For those students who say little in a class sometimes become rich contributors via e-mail, perhaps because they feel protected from the stares of others (Ehrmann, 1995). Therefore, students must be more active in learning and take more responsibility whether attending a satellite downlink site or delving deeper into a WWW-based lesson.

Learning is the core essence of all developing human beings. But when we talk about education, the first thing that comes to our mind may be schools, colleges, universities, training centers or some forms of physical infrastructure where the process of teaching and learning takes place.

" The tools have change, the job hasn't" Ricl (1990) noted that, *"...new tools alone not create educational change. The power is not in the tool but use the community that can be brought together and the collective vision that they share for redefining classroom learning."*

For generation, conventional classroom-based learning is the basis of education. But, with the development of science and technology in education, it has given rise to the opportunity and potential of web-based learning environment beyond the four walls of the conventional classroom-based learning environment. Technology is becoming an important component of teaching and learning in our education. It provides more and more instruments and methods to help the system of education. Besides, it has also brought about a radical change in how information can be represented and increased the capability of the learner to record, access and retrieve it.

1.1 Research Objectives and Purposes

1.1.1 General Objectives And Purposes

This study designs and evaluates a web-based learning environment. The purpose of the learning site is to teach students the fundamentals of academic learning in mandarin and motivate them to work on the net independently on their free area time.

1.1.2 Specific Objective

Specifically, this study aims to:

- Design and develop a web-site for learning mandarin.
- Identify students' perceptions towards web-based learning.
- Compare the capacity of cognitive load between web-based learning and classroom learning.
- Compare the effectiveness between web-based learning and classroom learning.

1.2 Research Question

The research questions of this study are as below:

1. What is the student perception towards the developed system of this study?
2. What are the students' perceptions towards web-based learning?
3. Which of the method for learning mandarin require higher cognitive load?
4. Which is the most effective method between web-based learning and classroom learning?

1.3 Problem Statements

Web-based learning focuses on the needs of individuals' levels, and conventional classroom-based learning must be scheduled in advance and set by the group rather than individual. As the learning organization grows bigger and complicated, the problem of teaching staff shortage arises. Furthermore, there is also a problem of finding enough classroom halls. With web-based instruction, students can learn courses through web-sites, either at their home or other places at any time of the day and need not have to travel to a central classroom learning face to face with lecturers.

According to Bao et.al (1996), conventional classroom-based learning environment using textbook, speech and slide projectors is unable to propagate a mass of knowledge. This method is discrete, abstract and cannot promote high interest among students in their learning process. Hence, by integrating sound, motion, image and test, it will help to create a new, rich learning environment in the learning process; that is what the web-based learning can provide but not classroom-based learning.

Time is an important factor in learning environment. Conventional classroom-based learning is formalized and scheduled; it has a specified beginning and ending times of courses. Therefore, conventional classroom-based courses learning may be viewed as a one-shot opportunity and did not offer continuous learning opportunities. However, web-based learning not only provides learners with continuous learning option, but it also can suit the learner's scheduling needs.

With an accessible, timeliness, interactive, effective, engaging and enjoyable web-based learning environment, it can offer a rich environment for presenting information of courses and help to meet a much wider range of learning objectives (Alden, 1998).

1.4 Distance Learning

Web-based learning, which is also known as online learning is one form of distance learning.

Distance learning was defined by the America Council on Education as:

" A system and a process that connects learners with distributed learning resources. While distance learning takes a wide variety of forms, all distance learning is characterized by:

(1) separation of place and/or time between instructor and learner, among learners, and/or between learners and learning resources, and (2) interaction between the learner and instructor, among learners, and/or between the learners and learning resources conducted through one or more media: use of electronic media is not necessarily required." (American Council on Education, Guiding Principles for Distance Education in a Learning Society, 1996,p.10)

Furthermore, there are two different categories of distance learning delivery system, which are synchronous and asynchronous. Distance learning of synchronous instruction requires the simultaneous participation of all students and instructors and the interaction is always done in "real time". Some example forms of synchronous delivery system are Interactive TV, audio graphics, computer conferencing, IRC, and Moo. For distance learning of asynchronous instruction, it does not require the simultaneous participation of all students and instructor. Rather, students may choose their own instructional time frame according to their schedules. Some forms of asynchronous delivery system are emails, audiocassette courses, videotaped courses, correspondence courses, and WWW-based courses.

However, asynchronous instruction is more flexible than synchronous instruction, where students can choose the location, time with interaction opportunities also given for all students.

1.5 Web-based Learning

As noted before, web-based learning is one form of distance learning, which learners can learn over World Wide Web of Internet.

Internet is a large set of computer networks that communicate with each other over telephone lines. As described by Cerf, Internet is a global network, which is linked by means of the TCP/IP and other protocols. It enables more than 20 million users share information with one another in near real time. (Broadband Services Expert Group, 1994, p4) It is a grand collaboration for companies, organizations, individuals, schools and governments to share information and cooperates to maintain the infrastructure across the world. It also means that nobody owns the Internet. Therefore, learning through the Internet or simply as web-based learning environment can be convenient to the learners. It allows learners to select the time, place and pace of learning.

Moreover, web-based learning is more learner-centered compared with conventional classroom-based learning, where the learning environment is more focus on the learners and more flexible to meet an individual's specific learning needs. Besides, web-based learning also enables the learners to be more self-directed in managing their knowledge.

As a result, web-based learning environment will change the way we learn compared with the conventional classroom-based learning. It made the learning become a self-service, on-demand and media-rich experience. Anyway, the best feature about web-based learning is it allows learners the ease of tracking down the resources when and where they are needed.

1.6 Human Computer Interaction (HCI)

HCI can be defined as a set of processes, dialogues or actions through which human employs and interacts with a computer (Baecker & Buxton, 1987,p.40). Another definition for a more recent and broader characterization of HCI is " *Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing system for human use and with the study of major phenomena surrounding them*" (ACM SIGCHI, 1992, p.6).

The goals of HCI are to produce a usable and safe, as well as a functional system. The goal can be summarized as *"to develop or improve the safety, utility, effectiveness, efficiency and usability of system that include computers"* (Interacting with computers, 1989,p.3). The key concept of HCI is **usability'**, it is concerned with making the system easy to learn and to use.

Figure 1below shows the main topics that make up the discipline of HCI.

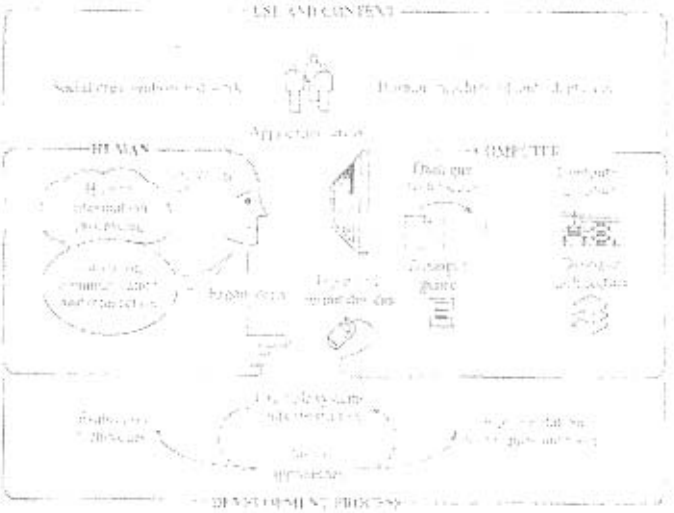


Figure 1 Human-Computer Interaction

One of the factors that should be taken into account in HCI design is **the user**. To improve the productivity of a product, may have an undesirable effect on users' cognitive processes and capabilities such as motivation, enjoyment, satisfaction, personality, experience level and so on.

"Human as information processor" was the main paradigm in cognitive psychology during the 1969s and 1870s. For everything that is sensed like sight, hearing, touch, smell and taste, it is considered to be information, which the mind processes. All information will enter and exit the human mind through a series of stages as shown below.

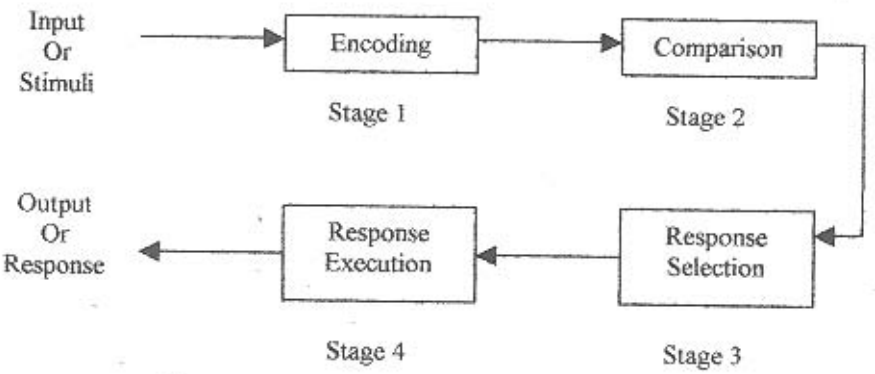


Figure 2 Human information processing stages (Adapted from Barber, 1988)

In general, cognition refers to the process of gaining knowledge. These include understanding, remembering, reasoning and so on. HCI is important as it represents how humans interact with computers. The research in HCI is essential to ensure that the user interface with the web-based learning system is user friendly, interactive, effective, and accessible.

CHAPTER TWO
LITERATURE REVIEW

2.0 Introduction

The literature review looks at the theories of learning, cognitive load, characteristics of a good measuring instrument, why web learning, some web-sited learning activities and related literature on the Internet.

2.1 Learning Theories

Learning theories have evolved to explain how human beings learn. Generally, there are two major groups of learning theories: cognitive theories and behavioristic theories (Bigge and Shermis, 1992).

Both theories agree that learning is a process by which behavior is either modified or changed through experience or training, but they disagree when describeing about how learning occurs and how to establish the best condition for learning.

2.1.1 Cognitive Theories

From the perspective of cognitive theories, learning occurs through a more general way of thinking. It developed a cognitive structure in our minds that allows us to formulate general working principles (Hamachek, 1995).

To a cognitive theorist, learning is seen as a deductive process, starting from the general to the specific and it gives the opportunity to study the learning event intact.

The cognitive approach to learning is concerned primarily with such topics as decision making, information processing understanding and to fuller understanding.

"Discovery learning" is an outgrowth of cognitive theory, which promoted the idea that learning occur when students are encouraged to understand immediately, to make their own errors and enable to find out their own answers to tasks that are structured for exploration (Bruner, 1983). According to Jerome Bruner (1983), discovery learning is not only more exciting to students but also can increase their self-confidence and self-reliance. This is a learning by discovering the solutions method.

The basic idea of this method is give a wide variety of example to students and encourage them to discover the answers or principles. As noted by Disvesta (1987), "The emphasis is on the total instructional event of which the learner is a part. The situational demands, the characteristics of the learner, the task demands, the purposes of the learner, and so

on interact to determine the quality and texture of the event, such as teaching or learning episode". (Psychology in Teaching, Learning and Growth, 1995, p.232)

Nevertheless, a basic principle to cognitive model of learning is the idea that the learner must be an active, searching and experimenting person in the process of learning.

2.1.2 Behavioristic Theories

Behavioristic theory is also referred to as stimulus-response (S-R) theory. Learning by behaviorist view occurs by studying the conditions (stimulus) outside a person that causes him or her to behave (respond) in certain ways.

A behavioristic or stimulus-response approach to learning enable us to study the more specific, discrete components of each learning event, which involve the specific aspects to more general components.

The method used by behavioristic theories to encourage learning is the reinforcement method. Reinforcement is contingent on the organism's behavior. Its purpose is to reinforce correct answers and proper behavior to increase the desired responses. As stated by Skinner (1987), this approach concentrates on how learning can be shaped, controlled and manipulated by reinforcing specific desired responses or behavior.

Basically, there are two situations of behavior learning: respondent behavior and operant behavior (Skinner, 1987). Respondent behavior occurs by response to a stimulus. Operant behavior, in contrast is not elicited by any known stimuli but emitted by a person.

Computer-Assisted Instruction (CAI) was designed to be a self-instructional package, which is based on operant-conditioning principles and use the basic principles of positive reinforcement to keep students involved in their use (Skinner, 1954). It is a learning approach that involves the use of computers as tutor to present information. Learners are allowed to participate in the program by responding to questions or solving problems and feedback occurs immediately after each response. This feedback is important, as learners require praise for their effort. It has a strong influence on an individual's future performance. For example, a simple praise like " you're right" will motivate learners especially the weak ones, to continue to try and learn again. As stated by Butler and Winne (1995), feedback is crucial in developing self-regulated learning, wherein learners monitor their own learning and the resultant performance.

An analysis by Kulik, Bangert and Williams (1983) towards about fifty studies involving sixth to twelfth-grade students had showed that those exposed to CAI had scored slightly higher marks on exam than students who were just taught in conversational ways. The learning style and capabilities are almost different among each individual. Bangert, Kulik and Kulik (1983), and Kulik, Cohen and Ebeling (1980) had found that low-achieving and very anxious students often benefit from CAI. Besides, Bullough and Betty (1991) had also found that learners are more cooperative and active socially when working with the computer.

Although both of the cognitive theories and behavioristic theories have something to offer, but no single learning theory is comprehensive enough to explain or include all that we need to know about how and why learning occurs. From the perspective of cognitive learning theory, it helps us to understand the need for developing a broad cognitive structure in coping with specific learning tasks. On the other hand, the behavioristic theories help us to better define the conditions under which particular types of learning must be broken into smaller subunits. So, a multitheoretical approach to better understanding learning is needed in response to a well-documented fact that people tend to develop individual cognitive styles and unique ways of organizing their experiences and learning (Ackerman, Sternberg, and Glasser, 1989).

2.2 Cognitive Load

Cognitive load refers to the total amount of mental activity imposed on working memory at an instance in time (Cooper, 1998). The major factor that contributes to cognitive load is the number of elements that need to be attended to.

As suggested by the cognitive load theory (Sweller, 1988), the effective instructional material facilitates learning by directing cognitive resources towards activities that are relevant to schema acquisition.

2.2.1 Extraneous and intrinsic cognitive load

The total cognitive load consists of extraneous and intrinsic cognitive load (Cooper, 1998) as shown in Figure 3 below.

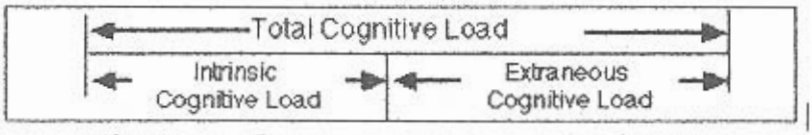


Figure 3 Extraneous and intrinsic cognitive load

Extraneous cognitive load is due to the instructional materials used to present information to students. However, the intrinsic cognitive load is due solely to the intrinsic nature (difficulty) of some to-be-learned content.

For extraneous cognitive load, the design of instructional material may modify the level of cognitive load. For example, if the given teaching materials addresses a concept such as continental drift, then it will be more effective if it makes an appropriate use of graphics rather than a text only presentation. Anyway, the intrinsic cognitive load cannot be modified by the design of instructional material, the high in element interactivity contents remains high in element interactivity and it is regardless of how it is presented to students.

Figure 3a shows that if a high level of extraneous cognitive load is imposed, by using sufficient mental resources a learner is still able to learn from "any" type of instructional material when intrinsic cognitive load is low (simple content).

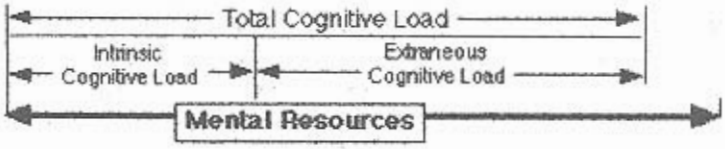


Figure 3a High level of extraneous cognitive load

Figure 3b shows that if the intrinsic cognitive load is high (difficult content) and the extraneous cognitive load is also high, then the total cognitive load will exceed mental resources and learning may fail to occur.

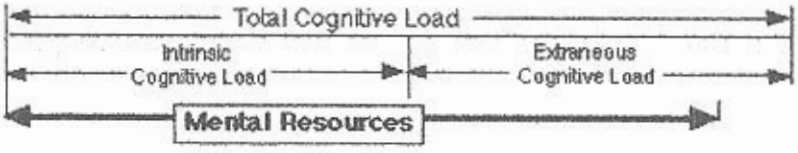


Figure 3b High level of extraneous and intrinsic cognitive load

Figure 3c shows that if the instructional materials can be modified to engineer a lower level of extraneous cognitive load and resulting total cognitive load falls to a level that is within the bounds of mental resources, then it will facilitate the process of learning.

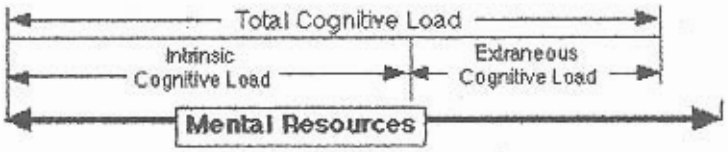


Figure 3c Modification of instructional materials to engineer a lower level of extraneous cognitive load

2.2.2 Principles of cognitive load theory

The theory of cognitive load focuses on the role of working memory in the learning process. As stated by Cooper (1998), there are some fundamental principles of cognitive load theory:

a) Working memory is extremely limited.

b) Long term memory is essentially unlimited.

c) The process of learning requires working memory to be actively engaged in the comprehension (and processing) of instructional material to encode to-be-learned information into long term memory.

d) If the resources of working memory are exceeded then learning will be ineffective.

2.3 Characteristics Of A Good Measuring Instrument

The most important characteristic of a good test used in learning is that it should be fair. It means that the material should reflect the instructional objectives and understood by students. From the point of measurement, a good instructional material should have two important qualities, that are validity and reliability (Lefrancois,1994).

2.3.1 Validity

Validity is an important characteristic of a measuring instrument. If an instructional material is valid, then it efforts to measure what it intended to measure. Otherwise, it does not measure what it purports to. As shown in figure 2 below, there are several different ways in measuring or estimating validity of a text.

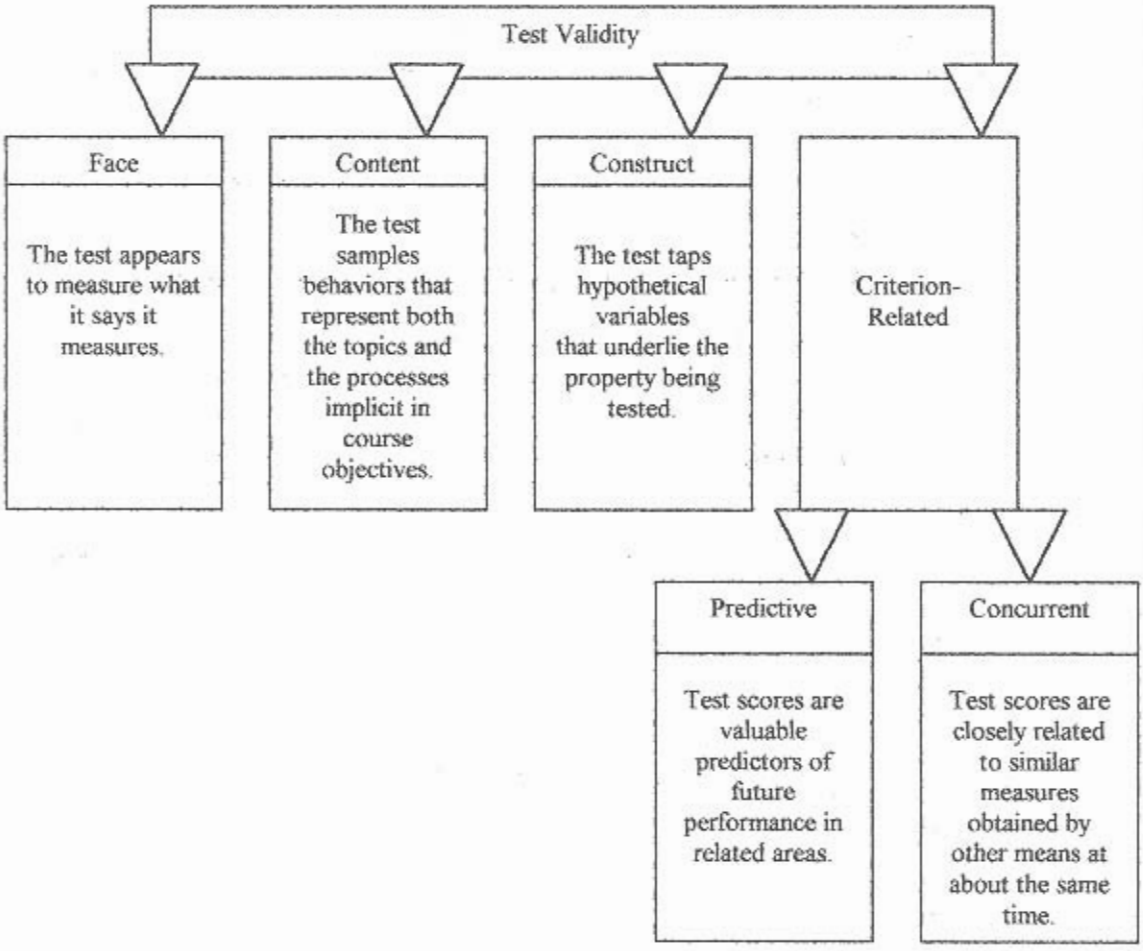


Figure 4 Types of test validity

Face Validity

Face validity is the extent to which a test *appears* to measure what it is supposed to measure. A test is considered to have face validity if the present test *looks* valid. Face validity is important because students should know just by looking at the test that they are being tested on the appropriate things. For example, if a mathematics test has face validity then it will consist of items that look like mathematics items.

Content Validity

Content validity is determined by analyzing the content of test items and comparing of this content with the objectives of the course. A test with high content validity includes items that sample all important course objectives in proportion to their importance. For example, if 40 percent of the objective of course content deals with the knowledge, then 40 percent of the test should assess knowledge.

Construct Validity

Construct validity is somewhat more relevant for many other psychological measures such as personality and intelligence test. An estimate of construct validity of a test designed is

based on the extent to which test results agree with and reflect the theories that underline the test.

Criterion-Related Validity

There are two aspects of criterion-related validity, which are predictive validity and concurrent validity. Predictive validity is measured by looking at the relationship between performance and subsequent performance on a test. However, concurrent validity is to measure the relationship between a test and other measures of same behaviors.

2.3.2 Reliability

Reliability is consistency with which a test measures whatever it measures. An instrument that is highly unreliable cannot be valid. There are two ways to assess the reliability: repeated-measures reliability and split-half reliability. Repeated-measure reliability is to correlate results obtained by giving the test twice and the split-half reliability is to divide the test into halves and correlate the scores obtained on each half (Wiersma & Jurs, 1985).

2.4 Why Web Learning

The most important reason that the Internet has become such a powerful strategic commercial phenomena is the World Wide Web. The World Wide Web is the universal interface to the world's digital. As such, it has a great potential for education because it gives learners instruction and instructional designers unprecedented access to information and to the experts who create it.

2.4.1 Some History About the Growth of the Web as a Learning Environment

As stated by Manasco (1996), United States had spend $ 50 billion per year on web-based training. Against that, the projections for Web-based training do indeed seem small, where Hall (1997) had estimated that web-based training will be a $1.5 billion industry in 2000, or just 3 percent of corporate training expenditures.

However, Web learning literally exploded out of nowhere in just a few years. The statistics below illustrate the phenomenal and the commentary in the growth of the Word Wide Web:

- As stated by Semilof (1997), there were 75,000 Web host (server) in January 1996 and it has increased to 408,382 within one year.

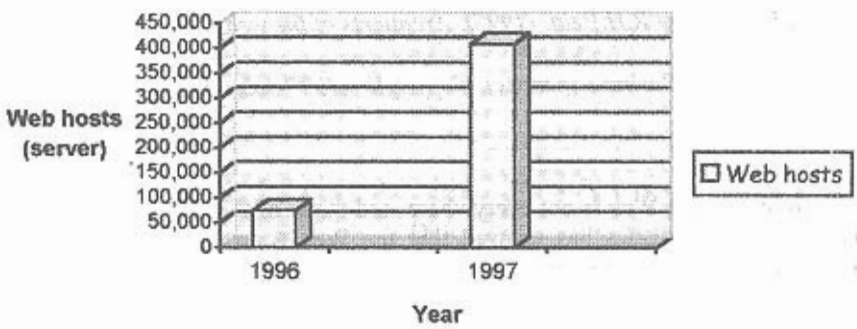
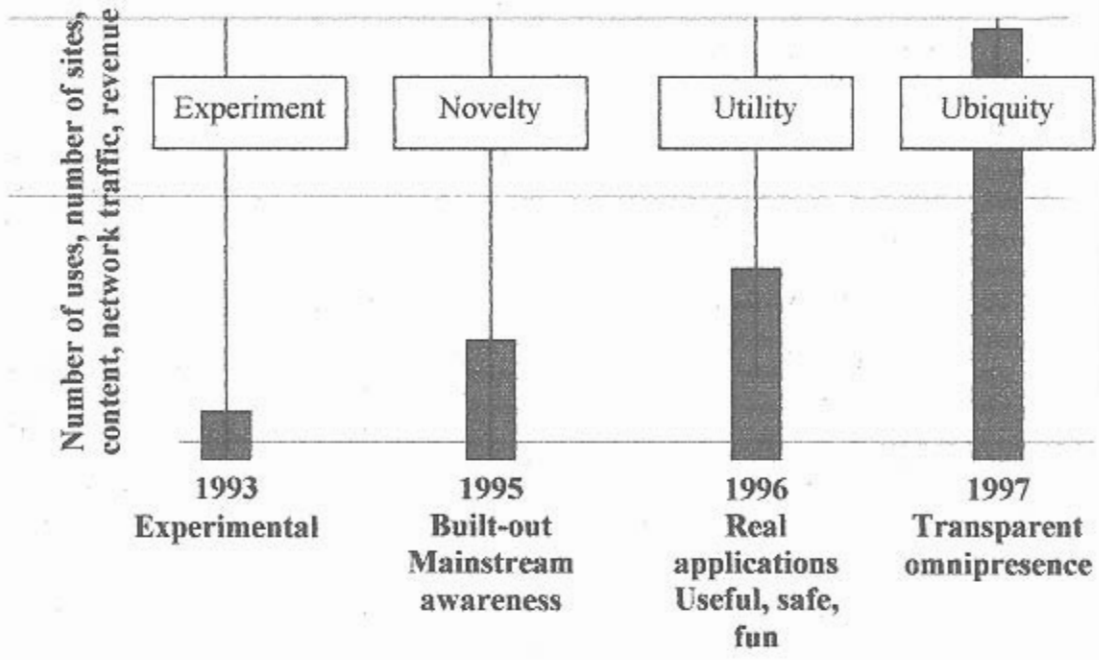


Figure 5 Web hosts

- McKegeny (1997) had found that the sale of Web–based training grew 80 percent from 1995 to 1996, and another 150 percent in 1997. Web-based training for information Technology professionals alone amounted to $ 92 million in 1996, with a projection of $ 1.7 billion in 2000.
- As reported in Electronic Education Report, the sale of Web-based curriculum for K-12 school is experiencing a yearly growth rate of almost 20 percent.
- Users of technical training materials predict that in the year 2000 the Web-based will be a more important training delivery vehicle than static computer-based training (CD-ROM) or electronic performance support systems (Bassi, Cheney, and Van Buren, 1997).

There are four stages of Internet development. As recently as 1993, the Web was still considered an experimental concept. However, the Web has moved from an intriguing experiment in information technology to an essential part as shown by figure 6 below:



Adapted from R.H.Reid. (1997). Architects of the web: 1000 Days that Buit the Future of Business (p.xxxiv). Copyright ©1997 John Wiley & Sons.

In reality, the Web is not everywhere, and many of the learners will not have access to it. However, the statistics has showed that the Web is here to stay and can therefore be considered as a potent tool for learning.